A Case Study on the Effect of Filter Micron Rating Change of Filtration System in Lancing Process

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1. Introduction

Lancing is the process of remove the corrosion products deposited on the top of the of the tube side of the secondary side of the steam generator and the surface of the tube during the nuclear power plant overhaul. The purpose of lancing is remove sludge deposit on the top of the steam generator tube sheet and on the surface of the tubing to prevent stress corrosion cracking, deterioration of heat exchange performance, and unstable water level of steam generator. Thus, the solid corrosion products generated from the secondary side of the steam generator are removed from the filtration system of lacing process and the filtration system uses a bag filter at the front and a cartridge filter at the rear end.

In this case study, we confirmed the influence of the micron rating of the filter used in the filtration system on the lancing process of Unit 1 of NPP.

2. Lancing process

2.1 Overview

The mail working place of the lancing process can be divided into the secondary side of the steam generator in the containment building, the process system container outside the containment building, and the control container. On the secondary side of the steam generator, a large amount of high-pressure water is injected into the barrel spray nozzle to remove the deposited sludge in the secondary side of the steam generator. The water and sludge generated are transferred to the surge tank installed in the process system container, the water in the surge tank is collected in the filter while the sludge is collected in the filter and the water is collected in the storage tank. The water in storage tank is reused to remove the sludge by spraying with a robot using different pumps according to the type and position of the sludge. The removal of sludge is carried out in the order of soft sludge, hard sludge and deviated hard sludge on top of the tube sheet. The lancing process is shown in Fig. 1.

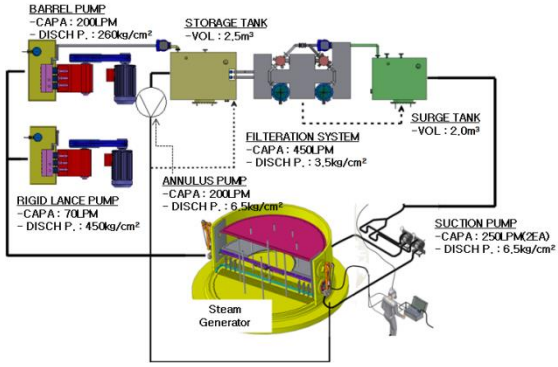

Fig. 1. Lancing process flow diagram.

2.2 Filtration system

The filtration system of the lancing process uses a bag filter to remove large particle sludge and a cartridge filter to remove small particle sludge. The filtration system consist of two filtration systems. One filtration system consist of one bag filter and nine cartridge filter, as shown in Fig. 2.

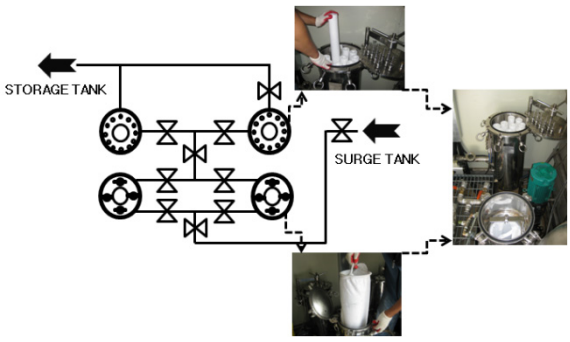

Fig. 2. Filtration system.

3. Effect of micron rating of filter

3.1 Filter usage

Table 1 shows the amount of filter used when the bag filter of 10 μm and 7.5 μm was used in the filtration system through the lacing process of S/G A, B, C. These results show that the use of the cartridge filter is significantly reduced when using a 7.5 μm bag filter, compared to using a 10 μm bag filter.

Table 1. Cartridge filter usage

Filter	S/G A		S/G B		S/G C	
	10μm	7.5μm	10μm	7.5μm	10μm	7.5μm
Bag	53	0	30	45	12	49
Cartridge	414	0	189	54	117	54

The amount of sludge removal was not significantly different between the two types of bag filters, although it may vary depending on the timing of use.

Table 2. Weight of sludge by micron rating of bag filter

Micron Rating	Quantity	Total Weight
10 μm	95EA	169.06 kg
7.5 μm	94EA	185.5 kg

3.2 Filtration system maintenance

Replacement of the filter is an important part of maintenance because the process may be stopped if the filter replacement of the filtration system is not performed in a timely manner during the lancing process. When replacing, be careful not to spill contamination on the floor. The replacement of the filter is performed when the differential pressure is 4.0 bar, and when the amount of sludge is large at the beginning of the lancing process, the differential pressure of the filter increase rapidly, and the replacement time of the filter becomes very fast.

The results of S/G B and C in Table 1 indicate that when 7.5 μm was used, the amount of cartridge filter used decreased but the amount of bag filter used increased. Therefore, when 7.5 μm is used, the bag filter replacement is increased and the replacement of the cartridge filter is decreased, so that the maintenance time is further increased.

Table 3. Number of replacements of the filter

Filter Type	10μm	7.5μm
Bag	42	94
Cartridge	33	12
Total	75	106

3.3 Waste

The spent filters generated in the process system container are to be stored temporarily with a waste label and carried out according to the procedure when moving to the radiation management area.

In the filter structure, the bag filter composed of a bag-shaped synthetic fiber and an upper ring, and the cartridge filter has a structure in which a cylindrical synthetic fiber surrounds a cylindrical plastic, so that the bag filter can be easily separated. When calculating the volume of only the synthetic fibers of the bag filter and the cartridge filter as the standard of the filter currently used, the volume of the cartridge filter is about 1.2 times larger than that of the bag filter. In addition, since cartridge filters also product plastic waste, it is advantageous to reduce the usage of cartridge filters in order to reduce waste.

3.4 Cost

The use of the filter is closely related to the cost of not only the purchase of the filter but also the processing of future filter wastes. Since the cartridge filter is many times more expensive than the bag filter and the waste disposal cost in high, it is advantageous in terms of cost to rationalize the use of the filter.

4. Conclusion

The use of filters in the filtration system during the lancing process greatly affects not only safety but also maintenance, waste treatment and purchasing costs. We plan to comprehensively estimate not only the number of years of operation of the NPP but also the amount of sludge generated in the previous cycle, and to find an efficient operation method of the filtration system corresponding to this, it is very important in the lancing process.

References

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